ARTERIOVENOUS ANEURISMS.[1]

A CASE OF TRAUMATIC ARTERIOVENOUS ANEURISM OF THE COMMON FEMORAL ARTERY AND VEIN—UNSUCCESSFULLY TREATED BY A NEW METHOD OF COMPRESSION—AND FINALLY CURED BY THE PROXIMAL LIGATION OF THE EXTERNAL ILIAC ARTERY EXTRAPERITONEALLY—WITH THE SUGGESTION OF THE APPLICATION TO THESE ANEURISMS OF THE MATAS METHOD OF OPERATION USED FOR ORDINARY ANEURISMS—AND THE MENTION OF SOME OTHER RECENT METHODS OF OPERATING.

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A YOUNG negro man of about twenty-three years of age, of athletic build and otherwise healthy, was admitted to one of the surgical wards of the Charity Hospital, New Orleans, in 1897, presenting a small, prominent, pulsating tumor, of somewhat oval outline, and about 5 by 6.5 centimetres (2 by 2½ inches) in measurement, situated directly over the course of the common femoral artery and vein, furnishing a marked vibratory thrill and a murmur, and the pulsations ceasing upon compression of the external iliac artery without the contour of the tumor being materially changed thereby. At a period, as nearly as remembered by the writer, of about ten days prior to entrance, he had been shot by a pistol, the ball entering the outer aspect of the left thigh, on a level, approximately, with the spine of the pubic bone, and ranging inward across the front of the thigh. He had gone to bed for a few days, during which he had not suffered especially, and, upon getting up, noticed the enlargement upon his thigh. At the time of his coming into the hospital the wound of entrance had healed entirely, no wound of exit existed; the patient walked into the ward unaided, and complained of nothing but the presence and discomfort of his tumor. The ball could not be located, and no complained-of symptom pointed to its locality.

A diagnosis of traumatic arteriovenous aneurism involving the common femoral artery and vein was made. The contour of the swelling suggested the varicose-aneurism type of arterio-venous aneurism; but it is known to be quite impossible, in the majority of cases, to discriminate between the varicose-aneurism type and the aneurismal-varix type prior to the actual exposure of the tumor in the field of operation. This was found to be so in the four cases operated upon and reported by Treves. It is right to say that there was a difference of opinion, among those who saw the above case, as to whether the artery alone was wounded, or the artery and vein, the majority concurring with the writer in the latter view.

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[1] Read before the Surgical Section of the New York Academy of Medicine, March 5, 1904.

Within the following two or three days, and before any systematic course of procedure was begun, the patient, unaided, and in the presence of a male nurse, urinated the pistol-ball which had inflicted the wound. The ball, as remembered, was one of .32 caliber, and was smooth and not changed in shape by contact with any hard object. The patient had complained of no symptom leading one to suspect the presence of this foreign body within the bladder, and could describe, when questioned, no symptom immediately following the injury suggestive of penetration of the bladder. He gave no evidence of bladder irritation before or subsequent to the expulsion of the ball by the urethra. At the time of its expulsion, he complained to the nurse of an unnatural sensation; there was a temporary stoppage of the flow of urine, and then the ball was forced through the urethra, dropping from the end of the penis into the vessel with a noise as though ejected with some force. It is not plain by what route the ball entered the bladder. Considering the point of entrance and the position, to the outer side, of the party firing the pistol, the most direct route would have been by passing through the thyreoid foramen of the innominate bone; but it would be difficult to see how that could be accomplished without greater damage to the vessels than a tearing off of a small part of the roof, or anterior aspect, of femoral artery and vein, which was supposed in this case. And if the ball ranged upward, over the superior border of the pubic bone, by way of the prevesical space, it must have met a very much distended bladder. There was no evidence that a fracture of the innominate bone had been sustained.

The patient was now put to bed, the bowels thoroughly moved, and a low diet instituted. Though realizing the usual inefficacy of methods of pressure, these were, nevertheless, tried.

Digital compression of the external iliac was first used, and, later, compression with a broad rubber bandage, applied from toes to hip-joint. Then a special form of compression, which suggested itself to the writer, was tried experimentally. The tumor and adjacent regions of thigh and groin were shaved; these parts were then lubricated with vaseline; upon this smooth lubricated surface, extending downward from Poupart's ligament for about fifteen centimetres (six inches) below, and around the anterior half-circumference of the thigh, wet plaster-of-Paris was put, being especially built up about the tumor, and when this had hardened and come away, a reverse cast of the part was obtained. Into that special part of the concavity of this hollow which represented, and was made by, the convex tumor, cotton was closely packed, until very nearly but not quite all of the cavity moulded upon the aneurism had been built up and obliterated. The whole cast was then replaced, so that it fitted very exactly the parts from which it was taken, except that the aneurism did not fully fill its former cupped-out cavity in the cast, but only occupied that concavity to a very small extent. This cast was then pressed well into position, and held firmly in place by a spica bandage, the entire limb being supported by ordinary bandage from the toes, the idea being to bring to bear a considerable degree of firm pressure and compression upon the aneurism by the forcing of it into a smaller, and especially shallower, cup than it had made in the original cast, aided by the purchase, so to speak, which the rest of the clinging cast secured by fitting so accurately the parts upon which it had been moulded. This apparatus was applied upon two occasions and kept on a number of hours, and, while it caused no marked discomfort, no result was accomplished by its use. The writer has not used this method of pressure and compression in any case of simple arterial aneurism, but believes that it might find some field of application in certain cases, provided any method of pressure were to be used at all.

It was now decided to first ligate the external iliac artery proximally, in hope that ligature of the artery above would suffice, and, should this fail, to subsequently ligate the femoral vein below the sac, or upon both sides, as indicated at the time of the second operation, thus giving the patient every chance to maintain his venous circulation intact if the arterial had to be so largely sacrificed as necessitated by ligature of the external iliac. After, therefore, giving the patient an opportunity to recover from the attempts just described, he was anæsthetized and the external iliac artery tied extraperitoneally, by an incision parallel with and 1.3 centimetres (one-half inch) above the outer two-thirds of Poupart's ligament, followed by a pushing upward of the intact peritoneum, the artery being readily exposed and ligated with silk. An exceptionally large, flat, lymphatic gland, completely saddling the artery and lying directly over the site of ligation, and rather closely adherent to the sheath of the vessel, was the only complicating feature encountered. The patient was put to bed with the entire limb surrounded with a cotton and gauze dressing from toes to hip, and additional warmth temporarily supplied by hot-water cans. The ensheathing of the limb was retained for about ten days, with occasional examination of the circulation of the toes, at the end of which time the wound-dressing and the ensheathing were removed. Union had been primary. The tumor had disappeared. At about the end of another week the patient left his bed, and during the following days, while he was under observation and walking about, no return of the circulation in the aneurism occurred.

An interesting question, and probably the most interesting one in connection with the case, comes up as to whether, in the present light, this would have been the best course of procedure; although, in this particular instance, all ended well. It is known that with the more general use of weapons of small caliber, arteriovenous aneurisms are of more frequent occurrence than formerly. And the risks of gangrene, and even death, following the ligation of the larger arteries and veins are well known. The statistics of both pre-antiseptic and antiseptic days show this. In Van Buren's report of seven cases of ligation of the external iliac or common femoral artery for arteriovenous aneurisms, gangrene followed in all. Curtis collected fifty-one cases of arteriovenous aneurism in general, treated by ligation, of which twenty-three died, eight were cured, two improved, eighteen unimproved, and gangrene occurred in eleven cases. Billroth found he had secondary hæmorrhage in 50 per cent. of all large vessels ligated in continuity. Murphy reports twentytwo ligations of the femoral artery and vein, with gangrene in twelve. He has collected 178 cases of ligation of the femoral artery alone, with gangrene in twenty-five. He also reports thirty-one ligations of the femoral artery for aneurism, with hæmorrhage in 60 per cent. and death in 40 per cent. From these figures, though very imperfectly covering the field, it is clear how many lives are lost through the cutting off by ligature of the main blood supply of the parts. Recognizing, therefore, the present greater frequency of arteriovenous aneurisms, and the large proportion of disastrous results following ligation of the larger vessels, it would seem wise to devise some more satisfactory method of treating this form of aneurism. The most usual and the most successful form of operative treatment of these cases resorted to until comparatively recently has been some form of ligation, either of the artery above the sac, or above and below, with or without ligation of the vein below the sac, or below and above; the best procedure generally being considered to be the ligation of the artery and vein above and below the aneurismal sac, followed, in cases of the varicose-aneurism type of arteriovenous aneurisms, by excision of the sac, or as much of it as possible.

The operation performed by the writer in the above case was done before the introduction of the Matas' epoch-making method of operating for aneurism, and the writer is not aware that the Matas method has ever been used, or suggested, in the case of arteriovenous aneurisms. If not, he would suggest the application of this more modern method of operating to this special class of aneurisms, provided the conditions present offered an opportunity to apply the principles of that operation, and thus endeavor to not only preserve the integrity of the artery and vein, but also, in consequence, to spare the patient the great risk attendant upon the loss of circulation through one or both of these vessels. It is a known fact, as mentioned above, that the nature of arteriovenous aneurism cannot always be determined clinically, and, in some cases, is only discovered when the site has been exposed by operation. But it would seem warrantable to expose the aneurism in every appropriate case; and if the Matas operation be then found inapplicable, one of the more usual methods just mentioned could be adopted, or the original wound could be closed, and the artery ligated proximally, at some distance above, or one of the methods, other than the Matas method, to be mentioned below, might be used.

If the arteriovenous aneurism were of the varicose-aneurism type (that is, with an aneurismal sac intervening between artery and vein and communicating with both vessels by separate mouths), the writer would be inclined, where circumstances were favorable, to apply the Matas method, namely, after temporarily controlling the circulation through the involved vessels, lay open the intervening aneurismal sac, locate both the arterial and venous openings into it, and close them off by fine chromic gut Lembert sutures applied interruptedly, followed by obliteration of the sac in his characteristic manner of suturing its roof, including the overlying parts, to its floor. It is to be remembered that an endothelial layer usually lines the cavity of an arteriovenous aneurism, and is especially apt to be present near the openings into the sac; although the absence of an endothelial lining would not seem to be a contraindication to the application of this method, as the surfaces of even a pure connective-tissue sac could be roughened by curettement to promote adhesions of its walls. This technic is shown in Fig. 1.

If the arteriovenous aneurism were of the aneurismal-varix type (that is, a varicosed dilatation of a vein caused by the force of the arterial circulation poured into it through a direct communication from an artery, without an intervening aneurismal sac), and the conditions were favorable for this form of operation, while the typical Matas method, owing to the absence of a sac, might not be so applicable, yet a modification of that method would seem feasible. And here the writer would suggest the following modification of the Matas technic, namely, make a longitudinal incision through the enlarged and varicosed vein for as limited an extent as would seem to afford approach to the opening into the vein, and so placed as to lie directly opposite this communicating opening from the artery, retract the lips of this wound in the vein, thus

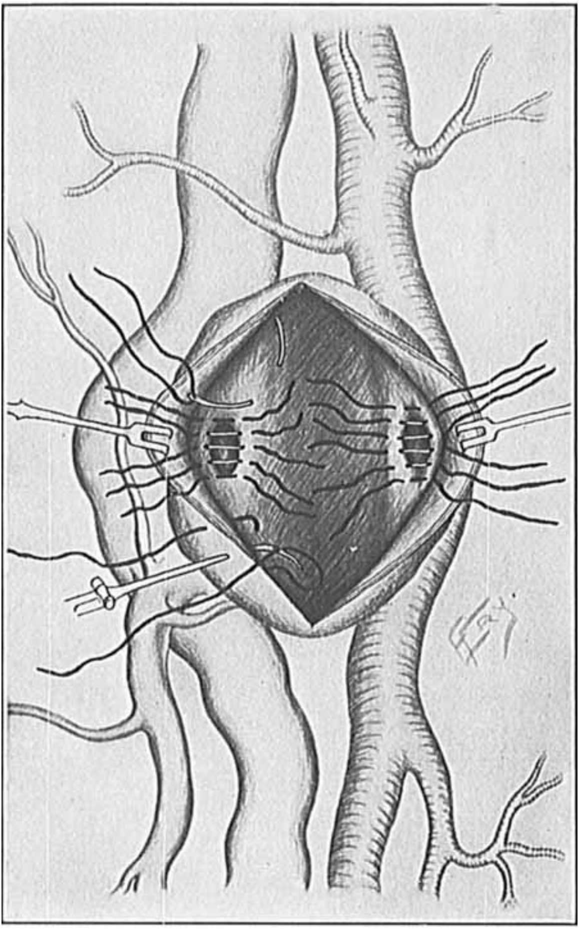

Fig. 1.—Varicose-aneurism type of arteriovenous aneurism of left common femoral artery and vein—showing the application to this class of aneurisms of the Matas method of operating upon ordinary aneurisms. The opening of the femoral artery into the common aneurismal sac is shown on the right, with interrupted Lembert gut sutures in position, ready to be tied. The opening of the femoral vein is seen on the left, with similar Lembert sutures in position. On the left of the sac two gut sutures are in the act of being placed, which, when tied, will approximate the roof of the sac (including skin and intervening tissues, which are not here shown) to the floor of the sac. Similar sutures will approximate the roof and floor of the sac upon the right.

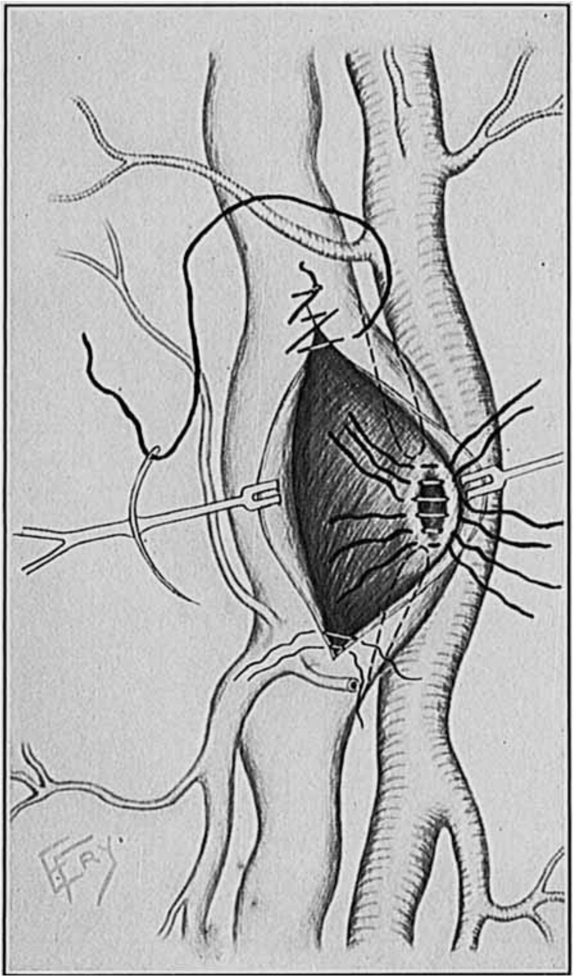

FIG. 2.—Aneurismal-varix type of arteriovenous aneurism of left common femoral artery and vein—showing the application to this class of aneurisms of the Matas method of operating upon ordinary aneurisms. The opening of the femoral artery into the varicosed vein is shown, with interrupted Lembert gut sutures in position, ready to be tied. The longitudinal incision in the vein, for approaching the arteriovenous opening (and which is here made somewhat unnecessarily long) is shown in the act of being closed by two methods of suturing—above, by the continuous Lembert of the outer coats—below, by interrupted ordinary sutures of the outer coats.

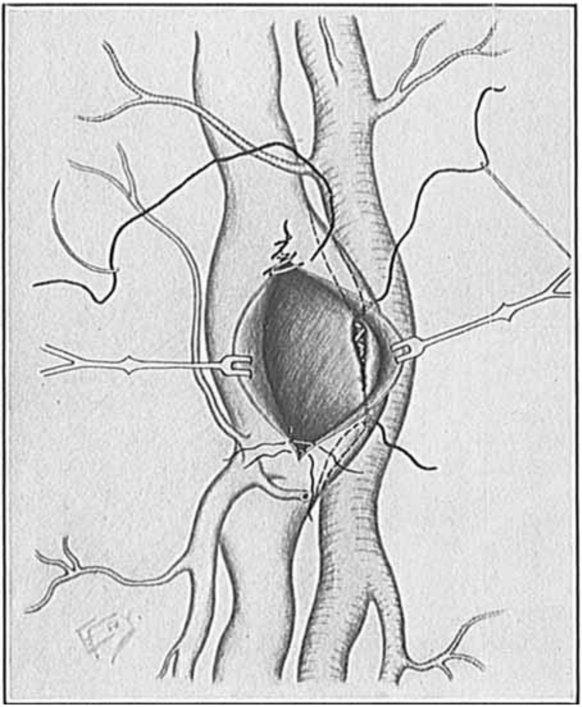

FIG. 3.—Same as Fig. 2, showing a continuous Lembert gut suture, which, having been passed through the outer coats of the thickened vein at the angle of junction of vein and artery, and knotted, is passed on between the coats of the vein until its varicosed cavity is entered very near one end of, and immediately above, the first tier of interrupted sutures—and is then made to bury-in this first tier and itself in continuous Lembert fashion—and, emerging at the opposite angle of junction of vein and artery, is tied in the same manner as at its entrance. (This suture is not yet tightened throughout.)

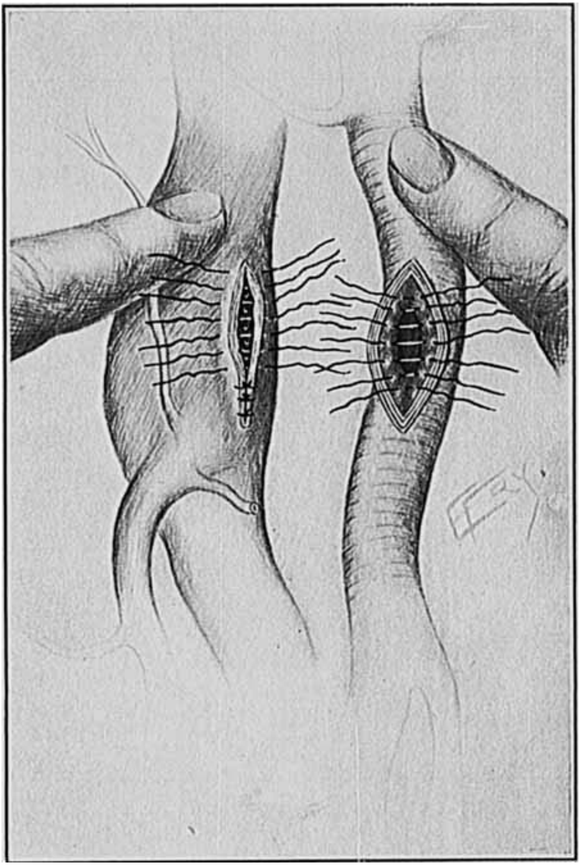

FIG. 4.—Varicose-aneurism of left common femoral artery and vein, treated by excision of the sac, followed by suturing of the openings in the vessels. Upon the right, a small elliptical piece of the sac is shown connected with the arterial opening, with the first tier of interrupted Lembert gut sutures in position, ready to be tied. Upon the left, a similar elliptical piece of sac has been left connected with the venous opening. The first row of Lembert sutures has been tied, and a second tier of ordinary sutures through all the coats is being applied, burying-in the first tier. Fig. 4 is the same as Fig. 1, with the sac excised.

exposing the interior of the vein and the arterial communication, suture up the opening of the artery into the vein in the usual Matas manner, and then close the incised vein by a continuous lateral suture of, approximately, the Lembert type. Fig. 2 illustrates this technic. Owing to the fact, in aneurismal-varix cases, that foreign material will be left in contact with the venous current by this manner of suturing (which does not apply in the varicose-aneurism cases), with the consequent theoretical possibility of pieces of the suture forming emboli, it would be well to use very fine gut for this suture, and to tie very small, closely-cut knots. Or it would be better still to bury-in the row of interrupted Lembert sutures closing off the arterial opening, by means of a continuous buried suture introduced from without entirely through the vein, at one of the angles of junction of artery and vein, passing in continuous Lembert fashion above the interrupted sutures, through part of the thickness of the wall of the vein, and out through the entire thickness of the vein at the opposite angle of junction of artery and vein, in very much the same manner as a subcuticular suture is passed, and so placed that the suture throughout its entire length and its points of entrance and exit, to and from the vein, are also buried, which, in the case of a thickened, varicosed vein would be easier of accomplishment than in a normal vein. This second tier of suturing is shown in Fig. 3.

More recently, successful artery suturing and vein suturing have been demonstrated, and these principles have been applied to arteriovenous aneurisms. In those cases of the varicose-aneurism type where both arterial and venous circulation can be controlled proximally to the sac, and the sac exposed by dissection, the aneurismal sac may, in appropriate cases, be excised up to very near the arterial and venous openings into it, and these openings then closed by a row of interrupted Lembert gut sutures, followed by a second burying-in row through the free margins of the small portion of the sac left around the jug-like opening into the artery and vein, as shown in Fig. 4. In those cases of the aneurismal-varix type, where, similarly, both the arterial and venous circulation may be arrested proximally to the arteriovenous communication, and this site of communication be exposed by dissection, the artery and enlarged vein may, in appropriate cases, be severed from each other by an incision through the connecting opening, made parallel with artery and vein, and these openings closed by lateral ligation with fine gut or silk, the openings left by the incision of the connection between artery and vein being, in the aneurismal-varix, less jug-like and with less free margin than in the varicose aneurism. This technic is shown in Fig. 5. If necessary, these openings left by the liberating incision could be trimmed into elliptical shapes.

It is also to be remembered that portions of arteries have been excised and the integrity of the vessel established by circular arteriorrhaphy. And Dörfler has demonstrated that suture material may be safely carried through all coats of arteries and veins without producing thrombosis. So that the range of dealing with vessels by methods of suturing has been very much increased in recent years.

Matas [1] himself states that he did not contemplate the application of the method which he devised for ordinary arterial aneurisms to arteriovenous aneurisms, and to circumscribed or diffuse pulsating hæmatomas of recent origin, resulting from arterial and venous wounds, leaving these types of aneurism for the methods of arteriorrhaphy and venorrhaphy. While recognizing that it is ideal to excise the aneurismal sac of a varicose aneurism and suture up the openings in the artery and vein, and to cut apart artery and vein in an aneurismal varix and somewhat similarly suture up the openings in the vessels which the severing of the common connection between them has left, leaving the circulation intact in both class of cases; yet there must occur cases in which there is difficulty of satisfactorily exposing the parts, or where there is difficulty in, and contraindication to, the removal of the sac of a varicose aneurism, or the

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[1] See "An Operation for the Radical Cure of Aneurism based upon Arteriorrhaphy," by Rudolph Matas, ANNALS OF SURGERY, Vol. xxxvii, No. 2, page 161.

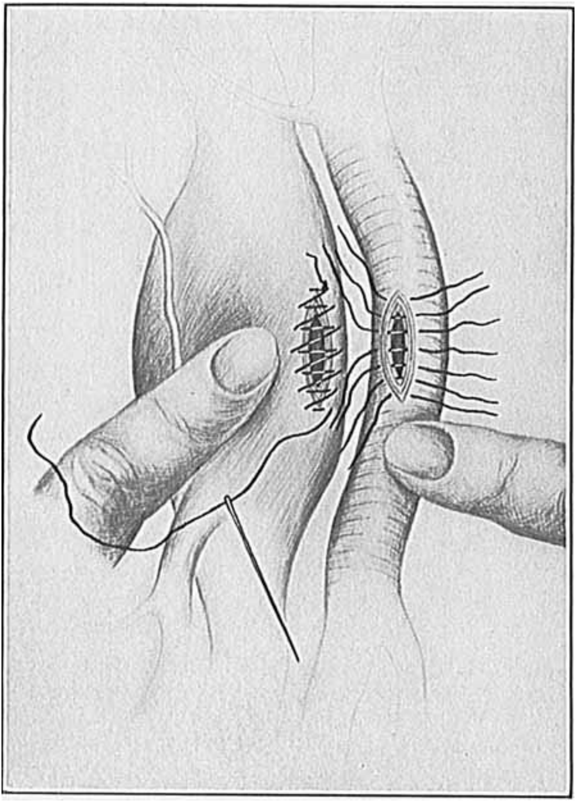

FIG. 5.—Aneurismal-varix of left common femoral artery and vein, treated by severance of vessels from each other, followed by suturing of their openings. On the right, interrupted gut sutures are shown passing through the outer coats of the artery, ready to be tied. On the left, a continuous Lembert gut suture through the outer coats is shown closing the venous opening. *Fig.* 5 is the same as *Fig.* 2, with the vessels cut apart.

cutting apart of artery and vein in an aneurismal varix, and in such cases the Matas method would seem to be a desirable technic. And while one feature is common to all of these more modern methods, and that is, the retention of the circulation through artery and vein, yet it may be questioned where, from the circumstances of the case, it is optional, whether the Matas method would not really be preferable in dealing with the varicose aneurism type of cases; for it would seem the suturing together of the roof and floor of the sac would strengthen the suturing of the arterial and venous openings into the sac and make secondary hæmorrhage less likely, and also accomplish the end with less traumatism.